

# Indian Rose Annual - IRA 1991

## ROSE BREEDING FOR THE TROPICS

M. S. Viraraghavan

Producing better roses for India and other tropical regions is indeed a challenging task. In addition to the normal difficulties of any plant breeding programme, warm climate rose breeding carries with it the daunting implication of having to deliberately reverse the conscious process of selection for resistance to cold, or winter hardiness, which has been basis of Western rose breeding for well over 100 years.

Broadly speaking, two approaches are feasible :

1. Evolving a strain of heat resistant roses starting with standard modern roses e.g. Montezuma, or heritage roses e.g. Gruss an Teplitz, with good performance in warm climates.
2. Breeding with tropical rose species, *Rosa clinophylla* (*Rosa involucrata*)<sup>1</sup> and its near relative, *Rosa bracteata*.

In this paper an attempt is made, in summary form, to set out the results achieved by adoption of these two alternate strategies of rose breeding in the light of work done, and observations made by various Indian rose breeders including the work done by the author from 1966 onwards.

A disclaimer or a plea for anticipatory bail would be in order, before we begin this article which, while striving for scientific accuracy to the extent information is available is unashmedly from the point of view of the practical horticulturist. As such inclusion of a certain amount of material based on intuition or 'feel' has become inevitable. In fact, without this element, it is difficult to do justice to the subject of rose breeding. May I add that this is not just the author's view - that the mechanics of rose breeding are easy enough, but that the flair for the right cross is not so - but is one well supported by various well known authorities e.g. Sanday<sup>3</sup>.

One other important factor, which has to be taken note of is the great variation in climate which exists within the tropics and, for that matter, within India itself. One authority, Sunil Jolly, has divided India into 10 agroclimatic zones for growing roses, and, in the ultimate analysis, separate breeding lines would be required for each of these 8 zones : <sup>4.5</sup>.

While on the subject of breeding tropical roses, adopting strategy 1, viz. working with standard/heritage varieties, which have performed well in the Indian climate, it is appropriate to begin with the work of Sri. P. Bhattacharji. Apart from being probably the first Indian rose breeder to recognise the need to create a separate line of heat resistant roses, Sri. Bhattacharji has the distinction of putting his theories into practical application by raising a large number of roses which were very well adapted to the agroclimate he was working in. Unfortunately not much information is available on the parentages of the roses raised by Sri. P. Bhattacharji; but it would appear that several of the hardy Hybrid Perpetuals, as well as varieties like the China polyantha rose, Cecile Brunner, other China/Polyantha roses, and some Tea roses, were utilized; e.g. his varieties Mukhadara (satin pink Floribunda) and Toohin (white Floribunda) appear to be derived from Cecile Brunner, while his apricot Hybrid Tea Raja Ram Mohan Roy appears to be linked with the Tea roses.

A serious effort to create such a line was initiated by the author from 1966 onwards. Among the varieties so chosen for the work were the China/Polyantha rose, Cecile Brunner, several of the Tea roses such as Catherine Mermet, Madame Falcot, and Etoile de Lyon, all of which are diploid. Other choices were the Bourbon rose, Rose Edward, and the Hybrid Musk, Prosperity, both of which are triploid, and the Hybrid Tea (Bourbon?) Gruss an Teplitz, which is a tetraploid. These varieties were intercrossed with a wide variety of garden roses, ranging from Polyantha/Miniatures, to standard large flowered Hybrid Teas/Floribundas, as also some climbers.

Table I sets out the work done on some of these varieties viz. Cecile Brunner and Catherine Mermet (diploid), R. Edward (triploid), and Gruss an Teplitz (tetraploid).

As is evident from the table, work with Cecile Brunner resulted in almost complete failure, except for the solitary pair of seedlings with the Polyantha, The Fairy. By hindsight it is quite evident that such a result should have been expected when crossing a diploid rose with mainly tetraploid garden roses. But there is yet scope to utilize Cecile Brunner, which, as many would confirm, is indeed very well adapted to different regions of India, in work with *R. clinophylla*, which is dealt with later. From (Catherine Mermet (?) x Samba), came the dwarf red Floribunda, First Offering.

Again, work with R. Edward did not lead to any tangible results. Nor did crosses with Prosperity - results which also could have been forecast, since triploid roses are inherently difficult to work with.

Fortunately, work with Gruss an Teplitz was much more rewarding and the author's lilac Hybrid Tea, Vanamali, the dark Pink Hybrid Tea, Kanchi, the pink Floribunda, Amrapali, are all derived from this line. In the next generation from Gruss an Teplitz has appeared the red Grandiflora, Achanta, from a cross with Kanchi.

Other rose breeders have also achieved some results using Gruss an Teplitz; e.g. Dr. Pal's Rose Sherbet, the Floribunda, Rosemary Rose, from which is derived the very popular red Floribunda Europeana (de Ruiter).

Another angle to the raising of heat resistant roses is the utilization of standard modern varieties of the type of Montezuma (well adapted to almost all the climates in India), Garden Party (at its best in cool, dry regions), Maria Callas (well adapted throughout India), and others too numerous to mention, specifically adapted for various agroclimatic zones.

One of the early successes using Montezuma was the author's Kanyakumari a repeat flowering climber in the salmon pink range of colour. Further work with Montezuma Maria Callas suffered a setback on account of the shift to Kodaikanal in 1980 from Hyderabad, where these varieties do not perform well. But there is little doubt that such an approach would be of great value and results could be achieved much more easily than when working with the heritage varieties.

Table: 1

### Results of Hybridisation with Cecile Brunner, Catherine Mermet, Rose Edward & Gruss an Teplitz 1966 – 1969

S. No.	Pollen Parent	Seed Parents (Illustrative List)	No. of Crosses	Hips Harvested	Seedlings Germinated	Remarks
1.	CECILE BRUNNER (Polyantha)	POLYANTHAS 1. Mr. BLUE BIRD 2. THE FAIRY  HYBRID TEAS	213	48	5	Work done at Nizamabad (Deccan Plateau) and Madras (EastCoast), only 2 seedlings from the cross Cecile Brunner x The Fairy found useful for further work.
2.	CATHERINE MERMET (?) (Tea)	1. KING'S RANSOM 2. TAPESTRY 3. INDEPENDENCE  FLORIBUNDAS	125	51	10	Work done at Nizamabad (Deccan Plateau). One seedling (Catherine Mermet (?) x Samba) was introduced as red Floribunda, "FIRST OFFERING"
3.	R. EDWARD (Bourbon)	1. LILAC CHARM 2. EUROPEANA	335	40	43	Work done at Nizamabad (Deccan Plateau) and Madras (EastCoast) and Hyderabad (Deccan Plateau). Seedlings generally very inferior, excepting for a cross (R. Edward x Golden Showers) from which 3 fragrant seedlings emerged.
4.	GRUSSAN TEPLITZ (Hybrid Tea/Bourbon)		305	88	Details misplaced	Work done at Madras (East Coast). From these crosses arose KANCHI (dark pink Hybrid Tea), and in a later generation VANAMALI (Lilac hybrid Tea) and AMRAPALI (Pink Floribunda)

As regards heritage varieties, we should observe that, apart from problems caused by diploid/triploid chromosome number, these varieties, in general, do not possess disease resistance as such. They appear to owe their longevity, under Indian conditions, more to disease tolerance, and the ability to recover from severe infection without special care or protective spraying. Varieties such as R. Edward and Cecile Brunner, though hardy, are exceedingly susceptible to mildew and this fault is much more pronounced in further generations raised from them.

Unfortunately, the same is true, by and large, of the Tea roses, which combine a moderate resistance to Black Spot with a great susceptibility to mildew (under Hyderabad conditions).

In passing, we should mention that the results with the heritage varieties appear a little more discouraging than perhaps might be the case, if it had been possible to *do* the work on a sustained basis in the same agroclimatic zone.

Coming to strategy II, i.e. hybridization with the tropical rose species, *R. clinophylla* (*R. involucrata*), possibilities in this direction have been pointed out by E.F. Allen<sup>2</sup>. But we cannot resist mentioning that the author's attempt ten years earlier in 1967, to obtain plants of *R. clinophylla* from the Botanical Survey of India, Sibpur, ended in failure, as *R. multflora* was sent from the gardens labelled as '*R. clinophylla*', and, ignorance compounded by a belief in the infallibility of the Botanical Survey of India led to several years being wasted before the mistake was discovered.

The strategy advised by Allen was to intercross *R. clinophylla* with varieties of the type of Tea/Noisette, Lamarque, which does well in many parts of the tropics. Allen observes that as is normally the case, the F<sub>2</sub> generation between a species and a continuous flowering hybrid is likely to be once flowering, but this could be overcome in subsequent generations, raised by setting or backcrossing to Lamarque, to yield recurrent, flowering climbers. According to him, a further generation raised by crossing such recurrent flowering climbers with fertile diploids would yield dwarf bedding roses suitable to the tropical climate.

The final step would be to cross the resultant diploid hybrids with selected

standard tetraploid garden roses, which would yield initially, triploids of low fertility, but eventually tetraploids would arise by much the same process through which they have evolved in temperate regions, among Hybrid Teas and Floribundas.

Before taking up an analysis of the results achieved with *R. clinophylla*, it would be useful to briefly describe the features of this species and its distribution in India.

The species is described by Dr. Pal in his well known book, 'The Rose in India' as a 'stout, erect or semi-climbing shrub, flowers white, single, borne singly or in clusters, fruits roundish, hairy and pale. Distribution throughout India, especially in the plains of Bengal' <sup>6</sup>. 'The foliage is light green, deeply veined with 5-7 leaflets with an apex leaflet considerably elongated, oblong lanceolate in shape. The curious involucras i.e. groups of bracts enveloping the young inflorescences are another feature by which the species can be easily recognised'

According to the classification adopted by Darlington, it is the only other member of the subgenus<sup>8</sup>. *Bracteatae*, of the genus *Rosa*, the other member being *R. bracteata*, native of South China and Upper Burma. Even from the horticulturist's point of view, the close resemblance between the two species is strikingly obvious. Under Kodaikanal conditions *R. bracteata* is, by far, the superior plant, possessing as it does, two very interesting, indeed, unique features :

1. Virtual immunity to mildew/black spot
2. Capacity to flower continuously.

As such, work on *R. bracteata* has been carried on simultaneously with that on *R. clinophylla*, with the expectation that the progeny would be easily intercrossable and the superior qualities of *R. bracteata* incorporated in the strain from the beginning itself.

Work started in 1985 with a clone of *R. clinophylla*, collected in the wild near Ranchi, Bihar State. Other clones have been reported from the Farakka Barrage area in West Bengal<sup>9</sup> and from the Mount Abu area in Rajasthan<sup>10</sup>.

In the initial years the work was carried on using *R. clinophylla* and *R.*

*bracteata* as pollen parents, following the recommendations of E.F. Allen<sup>2</sup>, that the cross, (cultivar x species) is more likely to succeed rather than the reverse. The seed parents employed included eight varieties of Tea and Noisette roses, provisionally identified as Marie van Houtte, Jean Ducher, Mrs. B. R. Cant (3 forms), Bouquet d'Or, Safrano, Lamarque, Celine Forestier, Marechal Neil; the polyanthas, Cecile Brunner Perle d'Or, Baby Farraux and Gloria Mundi; as well as certain Floribundas/Hybrid Teas which are exceptionally fertile under Kodaikanal conditions viz., Little Darling, Queen Elizabeth, Independence, Lover's Meeting and Julien Potin.

It can be seen that the first group are diploids, as is *R. clinophylla*, and the second group are all tetraploids. The results achieved are available in Table II.

An analysis of Table II clearly indicates that under Kodaikanal conditions utilizing *R. clinophylla* and *R. bracteata* as pollen parents, is not likely to yield tangible results. The crosses of *R. clinophylla* and *R. bracteata* with Polyanthas have been uniformly a failure. As regards crosses with Teas, only three seedlings have been raised with *R. clinophylla* of which two (T<sub>5</sub> Marie van Houtte? x *R. clinophylla*) and (T<sub>4</sub> Mrs. B. R. Cant? x *R. clinophylla*) have not yet flowered, even in the third season after germination. Seedling No. 3 (T<sub>4</sub> Mrs. B. R. Cant? x *R. clinophylla*) appears more promising as it is dwarf and has flowered twice with single white flowers of the type of *R. clinophylla* in the first season after germination.

**Table: IIa****CROSSES WITH R. CLINOPHYLLA AS POLLEN PARENT : 1985 – 1989**

S. No.	Seed Parents	No. of Crosses	Hips	Seed	Seedlings	Remarks
1.	T <sub>1</sub> (Madame Hoste?), Tea	5	--	--	--	
2.	T <sub>2</sub> (Boquet d'Or?), Tea	9	--	--	--	
3.	T <sub>3</sub> (Safrano?), Tea	14	13	6	--	
4.	T <sub>4</sub> (Mrs. B. R. Cant), Tea	23	17	27	2	of the 2, one has flowered (see text)
5.	T <sub>5</sub> (Marie Van Houtte?), Tea	16	4	13	1	
6.	T <sub>6</sub> (Jean Ducher?), Tea	8	1	5	--	
7.	T <sub>7</sub> (Celine Forestier?), Tea	6	--	--	--	
8.	Lamarque, Noisette	26	20	--	--	
9.	Marechal Niel, Noisette	2	--	--	--	
10.	Cecile Brunner, Polyantha	28	11	--	--	
11.	Perle d'or, Polyantha	30	10	--	--	
12.	Gloria Mundi, Polyantha	7	7	1	--	Too early. Germination may occur
13.	Echo, Polyantha	4	--	--	--	
14.	Gold Topas, Floribunda	2	--	--	--	
15.	Little Darling, Floribunda	10	6	20	--	
16.	Independence, Hybrid Tea	7	5	8	--	
17.	Queen Elizabeth, Hybrid Tea	4	4	6	--	

**Note:** ? Identification provisional



**Table: IIb****CROSSES WITH R. BRACTEATA AS POLLEN PARENT : 1985 – 1989**

S. No.	Seed Parents	No. of Crosses	Hips	Seed	Seedlings	Remarks
1.	T <sub>1</sub> (Madame Hoste?), Tea	1	--	--	--	
2.	T <sub>2</sub> (Boquet d'Or ?), Tea	4	--	--	--	
3.	T <sub>3</sub> (Safrano?), Tea	8	6	5	--	Only 1 survived. This is a dwarf single
4.	T <sub>4</sub> (Mrs. B. R. Cant), Tea	26	17	47	6	
5.	T <sub>5</sub> (Marie Van Houtte?), Tea	6	3	13	--	
6.	T <sub>6</sub> (Jean Ducher?), Tea	1	--	--	--	
7.	T <sub>7</sub> (Celine Forestier?), Tea	4	7	--	--	
8.	Marechal Niel, Noisette	1	--	--	--	
9.	Lamarque, Noisette	15	--	--	--	
10.	Lady Hillingdon, Tea	3	3	--	--	
11.	Cecile Brunner, Polyantha	2	--	--	--	
12.	Laurette Messimy, China	4	--	--	--	
13.	Rise 'n' Shine, Miniature	8	--	--	--	
14.	O'er The Rainbow, Miniature	5	2	5	--	
15.	Mini Cocktail, Miniature Seedling	16	11	1	--	
16.	Little Darling, Floribunda	27	22	50	1	Single, cream coloured flower of Floribunda type
17.	Baby Faurax, Polyantha	32	9	6	--	
18.	International Herald Tribune, Hybrid Tea	3	--	--	--	
19.	R. clinophylla, Species	76	70	230	45	

**Table: III****CROSSES WITH (R. Clinophylla x R. Bracteata) B as Pollen Parent**

S. No.	Seed Parents	No. of Crosses	Hips	Seed	Seedlings	Remarks
1.	T <sub>2</sub> (Boquet d'Or?), Tea	2	--	--	--	
2.	T <sub>4</sub> (Mrs. B. R. Cant), Tea	3	--	--	--	
3.	T <sub>5</sub> (Marie Van Houtte?), Tea	1	1	--	--	
4.	T <sub>7</sub> (Celine Forestier?), Noisette	3	--	--	--	
5.	Bharani, Polyantha	4	--	--	--	
6.	Little Darling, Floribunda	28	23	150	4	Not yet flowered
7.	Julien Potin, Hybrid Tea	1	--	--	--	
8.	Queen Elizabeth, Hybrid Tea	2	2	10	--	
9.	Rosy Mantle, Climbing Hybrid Tea	26	22	6	Still to germinate	
10.	Lovers' Meeting, Hybrid Tea	1	--	--	--	
11.	Self of (R. Clinophylla x R. Bracteata) B	12	3	12	5	Large variation in size/rate of growth F <sub>1</sub> plants

As regards *R. bracteata*, intercrossing with the Teas, only six germinations were recorded in cross (T, Mrs.B.R. Cant? x *R. bracteata*) of which one dwarf repeat flowering seedling has survived, which should be useful for further work. A *Clinophylla* crossed into tetraploids listed above has not yielded any result. But there is one dwarf Floribunda type seedling resulting from the cross (Little Darling x *R. bracteata*) with cream single flowers.

The only real success of the breeding programme is the raising of seedlings from the cross (*R. clinophylla* x *R. bracteata*). Of these seedlings five were treated at the first true leaf stage with 0.1% aqueous solution of colchicine, with the hope of inducing tetraploids. Two different treatments were adopted - a) immersion of the entire seedling (excepting for the root) in 0.1% colchicine for 8 hours, and b) treatment of the growing tip with 0.1% colchicine, 3 times daily for one week.

Two seedlings, identified as (*Clinophylla* x *Bracteata*) B and (*Clinophylla* x *Bracteata*) C have survived these treatments arising from the adoption of methods (a) and (b) respectively.

Of these, (*Clinophylla* x *Bracteata*) B has shown exceptional growth and freedom of flowering. Judged by appearances, this is very close to *R. bracteata*, the pollen parent. Several crosses have been made using this as pollen parent. as shown in Table III, The choice of tetraploid seed parents was based on the assumption that the seedling was a tetraploid. Subsequent investigations by Sambandamurthy et al of Tamil Nadu Agricultural University<sup>11</sup> showed however that this is a diploid with 14 chromosomes.

As is evident from Table III, the cross, tetraploid garden rose x *Clinophylla* x *Bracteata* is also one which is difficult to achieve. However, four seedlings from the cross (Little Darling x (*Clinophylla* x *Bracteata*) B) have survived but are yet to flower after one growing season. Judged by appearance, they are much closer to Little Darling, the tetraploid parent, which is obviously what should be expected. Five self seedlings of (*Clinophylla* x *Bracteata*) B have also been raised, which would hopefully be more fertile than the parent,

As using *R. clinophylla*/*R. bracteata* as pollen parents proved to be of little use, using them as seed parents was tried for the first time during 1989. The pollen parents used were the polyanthas, Perle d'Or, Cecile Brunner, as well as certain Hybrid Teas/Floribundas viz., Montezuma, Royal Gold, Fidelio, etc. A considerable quantity of seed has been harvested with the crossess of *R. clinophylla* and *R. bracteata* with Perle d'Or/Cecile Brunner. Germination has not yet commenced – October 1990. But there is yet time. Preliminary indications seem to be that using *R. clinophylla*/*R. bracteata* as seed parents would be more fruitful.

Before closing this account of work done with *R. clinophylla*/*R. bracteata* we venture on the following general points, which, hopefully, would be of use to other rose breeders. Clearly, *R. clinophylla* is genetically very distant from modern roses. There is also the problem of its being a diploid, whereas modern roses are generally tetraploid.

Additionally, *R. clinophylla* is, under Kodaikanal conditions, highly susceptible to both mildew and black spot. Unlike its close relative, *R. bracteata*, which, as mentioned earlier, is almost immune. The seedling (Clinophylla x Bracteata) B is also susceptible to mildew/black spot, though much healthier than *R. clinophylla* itself.

According to the work done by Dr. A. V. Roberts et al<sup>12</sup>, there would appear to be two different types of resistances to infection by black spot. The first type, based on cuticular resistance, and the second type, chemically based. According to these authors, 'from the breeder's point of view, a type of resistance is needed which reappears in at least a proportion of the progeny in undiminished strength. Such might be the case where resistance is conferred by a chemical that is controlled by a small number of genes.'

While we do hope that the resistance of *R. bracteata* is due to genetically controlled chemical factors, visual impressions (which may be quite wrong) appear to indicate that the resistance is of cuticular origin.

One other problem in breeding with *R. clinophylla* arises from the thin petal

texture of the flowers, no doubt due, partly at least, to the diploid chromosome number. Petal texture is a factor of great importance when breeding roses for warm climates and hopefully, this problem could be overcome if tetraploid progeny with the genes of *R. clinophylla* could be evolved by selective breeding.

We may mention in passing that detailed studies on the relation between corolla thickness and parentage of roses of the type done for rhododendrons by Pat Halligan<sup>13</sup> would be very useful indeed for rose breeders.

Breeding with *R. clinophylla* apart, we require a general strategy for rose breeding for the tropics. Here, the answer would be to concentrate on breeding roses which are evergreen as distinct from deciduous. We may observe that the deciduous characteristic has incidentally been encouraged by temperate climate rose breeding with an emphasis on winter hardiness. But in the tropics the situation is entirely different, and breeding an evergreen rose is well within the realms of possibility. It is of interest to note that some of the evergreen rose species e.g. *R. bracteata* itself, *R. laevigata*, *R. sempervirens*, have some of the most beautiful rose foliage imaginable. As far back as 1854, the well known English rosarian, Thomas Rivers, writing about *R. bracteata* and its good qualities, said he hoped that ultimately gardeners would not be satisfied unless all roses had evergreen foliage brilliant and fragrant flowers, and a long season of flowering. This might seem, he said an extravagant anticipation, but perseverance in breeding would yet achieve wonders<sup>14</sup>.

In more modern times, authorities such as Stelvio Cogliati<sup>15</sup> and Sam McGrady<sup>16</sup> have emphasized the need for beautiful rose foliage; in other words, evergreen foliage. McGredy has this to say - "Plant qualities are going to be important in the future. We tend to look on roses at present as something to fill a bed with colour for a few months, of the year. But I think that roses - or some roses - are going to become garden plants of beauty whether the blooms are on them or not".

**Table: IV****HYBRIDES OF EVERGREEN ROSE SPECIES**

S. No.	Evergreen Species	Hybrid Variety	Parentage	Remarks
1.	R. BRACTEATA	MERMAID	R. BRACTEATA x YELLOW TEA ROSE	Rampant everblooming climber with beautiful foliage and single cream flowers.
2.	R. BRACTEATA/ R. LAEVIGATA	MARIE LEONIDA	R. BRACTEATA x LAEVIGATA	Climber with large full cupped, yellowish, white flowers, glossy foliage.
3.	R. LAEVIGATA	SINICA ANEMONE	R. LAEVIGATA x TEA ROSE	Climber with clear pink single flowers.
4.	R. LAEVIGATA/ R. WICHURIANA	SILVER MOON	R. WICHURIANA x DEVONIENSIS	Large pale yellow flowers, semi double, on strong stems, foliage dark, leathery, glossy.
5.	R. SEMPERVIRENS	ADÉLAÏDE D'ORLÉANS	R. SEMPERVIRENS x Unknown	Climber with semi double pale pink flowers.
6.	R. SEMPERVIRENS	BONICA (Meidomonac)	(R. SEMPERVIRENS x MARTHE CARRON) x PICASSO	Shrub rose. Pink flowers, AARS 1982. Marthe Carron is pure <i>R. wichuriana</i>
7.	R. BANKSIAE/ R. LAEVIGATA	FORTUNIANA	R. BANKSIAE x R. LAEVIGATA	Double white climber. Widely used as rootstock.
8.	R. BANKSIAE	PUREZZA	TOM THUMB x R. BANKSIAE	White climber with profuse clusters.
9.	R. CLINOPHYLLA	LUCIDA DUPLEX	SPORT OR SEEDLING OF R. CLINOPHYLLA	Large double flower of white with rosy flush. Described by William Paul in "The Rose Garden" 1848.

While such thinking may appear novel, as for as roses go, the importance of foliage has long been recognised in other garden plants e.g. rhododendrons, where evergreen foliage and the capacity of the plant to hold foliage in good condition for several years has long been prized e.g. the article “Forget the flowers, breed for leaves” by Dr. M. J. Harvey<sup>17</sup>.

The romantic, indeed alluring, prospect of roses with brilliant evergreen foliage would appear to be well within the realms of practical possibility. Among the various rose species the following are evergreen or nearly so - *R. clinophylla*, *R. bracteata*, *R. sempervirens*, *R. banksia*, *R. laevigata*, *R. wichuriana*. All of them, apart from beautiful evergreen foliage, share one very important characteristic-viz., of being species native to the warmer portions of the world. The link between evergreen foliage and warm climate is hopefully very close indeed, and should be a source of inspiration for future rose breeders of the topic. Several hybrids have already been raised using various evergreen species (see Table IV which gives an illustrative list) but, as could be expected, evergreen foliage was not the main object with which the crosses were made. This fascinating prospect is left to the rose breeders of the future.

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Broadly speaking, two approaches are feasible:

1. Evolving a strain of heat resistant roses starting with standard modern roses e.g. Montezuma, or heritage roses e.g. Gruss on Teplitz, with good performance in warm climates.
2. Breeding with tropical rose species, *Rosa Clinophylla* (*Rosa Involucrata*)<sup>2</sup> and its near relative, *Rosa Bracteata*.

In this paper an attempt is made, in summary form, to set out the results achieved by adoption of these two alternate strategies of rose breeding in the light of work done, and observations made by various Indian rose breeders including the work done by the author from 1966 onwards.

A disclaimer or a plea for anticipatory bail would be in order, before we begin this article which, while striving for scientific accuracy to the extent information is available is unashamedly from the point of view of the practical horticulturist. As such inclusion of a certain amount of material based on intuition or 'feel' has become inevitable. In fact, without this element, it is difficult to do justice to the subject of rose breeding. May I add that this is not just the author's view - that the mechanics of rose breeding are easy enough, but that the flair for the right cross

is not so - but is one well supported by various well known authorities e.g. Sanday<sup>3</sup>.

One other important factor, which has to be taken note of is the great variation in climate which exists within the tropics, and, for that matter, within India itself. One authority, Sunil Jolly, has divided India into 10 agroclimatic zones for growing roses, and, in the ultimate analysis, separate breeding lines would be required for each of these 8 zones : 4.5.

While on the subject of breeding tropical roses, adopting strategy 1, viz. working with standard/heritage varieties, which have performed well in the Indian climate, it is appropriate to begin with the work of Sri. P. Bhattacharji. Apart from being probably the first Indian rose breeder to recognise the need to create a separate line of heat resistant roses, Sri. Bhattacharji has the distinction of putting his theories into practical application by raising a large number of roses which were very well adapted to the agroclimate he was working in. Unfortunately not much information is available on the parentages of the roses raised by Sri. P. Bhattacharji; but it would appear that several of the hardy Hybrid Perpetuals, as well as varieties like the China polyantha rose, Cecile Brunner, other China/polyantha roses, and some tea roses, were utilized; e.g. his varieties Mukhadara (satin pink Floribunda) and Toohin (white Floribunda) appear to be derived from Cecile Brunner, while his apricot Hybrid Tea 'Raja Ram Mohan Roy' appears to be linked with the Tea roses.

A serious effort to create such a line was initiated by the author from 1966 onwards. Among the varieties so chosen for the work were the China/polyantha rose, Cecile Brunner, several of the Tea roses such as Catherine Mermet, Madame Falcot, and Etoile de Lyon, all of which are diploid. Other choices were the Bourbon rose, Rose Edward, and the Hybrid Musk, Prosperity, both of which are triploid, and the Hybrid Tea (Bourbon?) Gruss en Teplitz, which is a tetraploid. These varieties were intercrossed with a wide variety of garden roses, ranging from polyantha/miniatures, to standard large flowered Hybrid Teas/Floribundas, as also some climbers.

Table 1 sets out the work done on some of these varieties viz. Cecile Brunner and Catherine Mermet (diploid), R. Edward (triploid), and Gruss en Teplitz (tetraploid).

As is evident from the table, work with Cecile Brunner resulted in almost complete failure, except for the solitary pair of seedlings with the polyantha, The Fairy. By hindsight it is quite evident that such a result should have been expected when crossing a diploid rose with mainly tetraploid garden roses. But there is yet scope to utilize Cecile Brunner, which, as many would confirm, is indeed very well adapted to different regions of India, in work with R. Clinophylla, which is dealt with later. From (Catherine Mermet (?) x Samba), came the dwarfed Floribunda, First Offering.

Again, work with R. Edward did not lead to any tangible results. Nor did crosses with Prosperity - results which also could have been forecast, since triploid roses are inherently difficult to work with.

Fortunately, work with Gruss en Teplitz was much more rewarding and the author's lilac Hybrid Tea, Vanamali, the dark Pink Hybrid Tea, Kanchi, the pink Floribunda, Amrapali, are all derived from this line. In the next generation from Gruss en Teplitz has appeared the red Grandiflora, Achanta, from a cross with Kanchi.

Other rose breeders have also achieved some results using Gruss en Teplitz; e.g. Dr. Pal's Rose Sherbet, the Floribunda, Rosemary Rose, from which is derived the very popular red Floribunda Europæana (de Ruiter).

Another angle to the raising of heat resistant roses is the utilization of standard modern varieties of the type of Montezuma (well adapted to almost all the climates in India), Garden Party (at its best in cool, dry regions), Maria Callas (well adapted throughout India), and others too numerous to mention, specifically adapted for various agroclimatic zones.

One of the early successes using Montezuma was the author's Kanyakumari a repeat flowering climber in the salmon



TABLE 1

Results of Hybridisation with Cecile Brunner, Catherine Mermat, Rose Edward, &amp; Gruss En Teplitz, 1948-1969

S.No.	Seed Parent	Pollen Parents	No. of Crosses	Pods Harvested	Seedlings Germinated	Remarks
1.	CECILE BRUNNER (polyantha)	(Extraverted Line) POLYANTHAS 1. Mr. BLUE BIRD 2. THE FAIRY HYBRID TEAS	213	48	6	Work done at Nuzumbad (Deccan Plateau) and Madras (East Coast); only 2 seedlings from the cross (Cecile Brunner x The Fairy) found useful for further work.
2.	CATHERINE MERMET (?) (Tree)	1. KING'S RANSOM 2. TAPESTRY 3. INDEPENDENCE FLORIBUNDAS	125	51	10	Work done at Nuzumbad (Deccan Plateau). One seedling (Catherine Mermat (7) x Samba) was introduced as a red Floribunda. "FIRST OFFERING"
3.	ROSE EDWARD (Bourbon)	1. LILAC CHARM 2. EUROPEANA	305	40	43	Work done at Nuzumbad (Deccan Plateau), Madras (East Coast) and Hyderabad (Deccan Plateau) seedlings generally very inferior, excepting for a cross (R. Edward & Golden Showers) from which 3 fragrant seedlings emerged.
4.	GRUSS EN TEPLITZ (Hybrid Tea/Bourbon)		305	88	Details misplaced	Work done at Madras (East Coast). From these crosses arose KANCHI (dark pink Hybrid Tea), and in a later generation, VANAMALI (Bicolor hybrid Tea) and AMRAPALI (Pink Floribunda).

pink range of colour. Further work with Montezuma Maria Callas suffered a setback on account of the shift to Kodalkanal in 1980 from Hyderabad, where these varieties do not perform well. But there is little doubt that such an approach would be of great value and results could be achieved much more easily than when working with the heritage varieties.

As regards heritage varieties, we should observe that, apart from problems caused by diploid/triploid chromosome number, these varieties, in general, do not possess disease resistance as such. They appear to owe their longevity, under Indian conditions, more to disease tolerance, and the ability to recover from severe infection without special care or protective spraying. Varieties such as R. Edward and Cecile Brunner, though hardy, are exceedingly susceptible to mildew and this fault is much more pronounced in further generations raised from them.

Unfortunately, the same is true, by and large, of the Tea roses, which combine a moderate resistance to Black Spot with a great susceptibility to mildew (under Hyderabad conditions).

In passing, we should mention that the results with the heritage varieties appear a little more discouraging than perhaps might be the case, if it had been possible to do the work on a sustained basis in the same agroclimatic zone.

Coming to strategy II, i.e. hybridization with the tropical rose species, *R. Clinophylla* (*R. involucreata*), possibilities in this direction have been pointed out by E.F. Allen<sup>1</sup>. But we cannot resist mentioning that the author's attempt ten years earlier in 1967 - to obtain plants of *R. Clinophylla* from the Botanical Survey of India, Sibpur, ended in failure, as *R. Multiflora* was sent from the gardens labelled as '*R. Clinophylla*', and, ignorance compounded by a belief in the infallibility of the Botanical Survey of India led to several years being wasted before the mistake was discovered.

The strategy advised by Allen was to intercross *R. Clinophylla* with varieties of the type of Tea/Noisette, Lamarque, which

does well in many parts of the tropics. Allen observes that as is normally the case, the  $F_2$  generation between a species and a continuous flowering hybrid is likely to be once flowering, but this could be overcome in subsequent generations, raised by selfing or backcrossing to Lamarque, to yield recurrent, flowering climbers. According to him, a further generation raised by crossing such recurrent flowering climbers with fertile diploids would yield dwarf bedding roses suitable to the tropical climate.

The final step would be to cross the resultant diploid hybrids with selected standard tetraploid garden roses, which would yield initially, triploids of low fertility, but eventually tetraploids would arise by much the same process through which they have evolved in temperate regions, among Hybrid Teas and Floribundas.

Before taking up an analysis of the results achieved with *R. Clinophylla*, it would be useful to briefly describe the features of this species and its distribution in India.

The species is described by Dr. Pal in his well known book, 'The Rose in India' as a 'stout, erect or semi-climbing shrub, flowers white, single, borne singly or in clusters, fruits roundish, hairy and pale. Distribution throughout India, especially in the plains of Bengal'. 'The foliage is light green, deeply veined with 5-7 leaflets with an apex leaflet considerably elongated, oblong lanceolate in shape. The curious involucres i.e. groups of bracts enveloping the young inflorescences are another feature by which the species can be easily recognised'.

According to the classification adopted by Darlington, it is the only other member of the subgenus<sup>9</sup>. *Bracteata*, of the genus *Rosa*, the other member being *R. Bracteata*, native of South China and Upper Burma. Even from the horticulturist's point of view, the close resemblance between the two species is strikingly obvious. Under Kodaikanal conditions *R. Bracteata* is, by far, the superior plant, possessing as it does, two very interesting, indeed, unique features :

1. Virtual immunity to mildew/black spot
2. Capacity to flower continuously.



As such, work on *R. Bracteata* has been carried on simultaneously with that on *R. Clinophylla*, with the expectation that the progeny would be easily intercrossable and the superior qualities of *R. Bracteata* incorporated in the strain from the beginning itself.

Work started in 1985 with a clone of *R. Clinophylla*, collected in the wild near Ranchi, Bihar State. Other clones have been reported from the Farakka Barrage area in West Bengal<sup>9</sup> and from the Mount Abu area in Rajasthan<sup>10</sup>.

In the initial years the work was carried on using *R. Clinophylla* and *R. Bracteata* as pollen parents, following the recommendations of E.F. Allen<sup>2</sup>, that the cross, (cultivar x species) is more likely to succeed rather than the reverse. The seed parents employed included eight varieties of Tea and Noisettie roses, provisionally identified as Marie van Houtte, Jean Ducher, Mrs. B. R. Cant (3 forms), Bouquet d'or, Safrano, Lamarque, Celine Forestier, Marechal Neil; the polyanthas, Cecile Brunner Perle d'Or, Baby Farraux and Gloria Mundi; as well as certain Floribundas/Hybrid Teas which are exceptionally fertile under Kodaikanal conditions viz., Little Darling, Queen Elizabeth, Independence, Lover's Meeting and Julien Potin.

It can be seen that the first group are diploids, as is *R. Clinophylla*, and the second group are all tetraploids. The results achieved are available in Table II.

An analysis of Table II clearly indicates that under Kodaikanal conditions utilizing *R. Clinophylla* and *R. Bracteata* as pollen parents, is not likely to yield tangible results. The crosses of *R. Clinophylla* and *R. Bracteata* with polyanthas have been uniformly a failure. As regards crosses with Teas, only three seedlings have been raised with *R. Clinophylla* of which two ( $T_5$  Marie van Houtte? x *R. Clinophylla*) and ( $T_4$  Mrs. B. R. Cant? x *R. Clinophylla*) have not yet flowered, even in the third season after germination. Seedling No. 3 ( $T_4$  Mrs. B. R. Cant? x *R. Clinophylla*) appears more promising as it is dwarf and has flowered twice with single white flowers of the type of *R. Clinophylla* in the first season after germination.



TABLE IIa

## CROSSES WITH R. CLINOPHYLLA AS POLLEN PARENT : 1985-1989

S.No.	Seed Parents	No. of Crosses	Hips	Seed	Seedlings	Remarks
1.	T <sub>1</sub> (Madame Hosta ? Tea	5	—	—	—	
2.	T <sub>2</sub> (Bouquet d'Or ?) Tea	9	—	—	—	
3.	T <sub>3</sub> (Salerno ?) Tea	14	13	6	—	
4.	T <sub>4</sub> (Mrs. B. R. Cant) Tea	23	17	27	2	
5.	T <sub>5</sub> (Mans Van Houtte ?) Tea	16	4	13	1	
6.	T <sub>6</sub> (Jean Ducher ?) Tea	8	1	6	—	of the 2, one has flowered (see text)
7.	T <sub>7</sub> (Calina Forestier ?) Tea	6	—	—	—	
8.	Lamarque Noisette	26	20	—	—	
9.	Marchal Niel Noisette	2	—	—	—	
10.	Cecile Brunner Polyantha	28	11	—	—	
11.	Petite d'or Polyantha	30	10	—	—	
12.	Gloria Mundi Polyantha	7	7	1	—	
13.	Echo Polyantha	4	—	—	—	Too early, Germination may occur.
14.	Gold Topas Floribunda	2	—	—	—	
15.	Little Darling Floribunda	10	6	20	—	
16.	Independence Hybrid Tea	7	5	8	—	
17.	Queen Elizabeth Hybrid Tea	4	4	6	—	

Note : ? Identification provisional

TABLE : II b

Crosses with *R.Bracteata* As Pollen Parent : 1995-1999

S.No.	Seed Parent	No. of Crosses	Hips	Seed	Seedlings	Remarks
1.	T <sub>1</sub> (Madame Houle?) Tea	1	—	—	—	
2.	T <sub>8</sub> (Boquet de Or) Tea	4	—	—	—	
3.	T <sub>9</sub> (Safano?) Tea	8	6	8	—	
4.	T <sub>4</sub> (Mrs. B.R. Cant?) Tea	26	17	47	6	Only 1 survived This is a dwarf single
5.	T <sub>8</sub> (Marie Van Hoyte?) Tea	6	3	13	—	
6.	T <sub>4</sub> (Jean Ducher?) Tea	1	—	—	—	
7.	T <sub>1</sub> (Celine Forester?) Noisette	4	7	—	—	
8.	Marchal Neil Noisette	1	—	—	—	
9.	Lanarque Noisette	15	—	—	—	
10.	Lady Hillington Tea	3	3	—	—	
11.	Cecile Brunner Polyantha	2	—	—	—	
12.	Laurette Messimy China	4	—	—	—	
13.	Rise 'n Shine Miniature	8	—	—	—	
14.	O'er The Rainbow, Miniature	5	2	5	—	
15.	Mini Cocktail Miniature Seedling	10	11	1	—	
16.	Little Darling Floribunda	27	22	50+	1	Single, cream coloured flower of floribunda type
17.	Baby Faneau Polyantha	32	9	5	—	
18.	International Herald Tribune Hybrid Tea	3	—	—	—	
19.	R. Clinophylla Species	76	70	200+	45	

TABLE III

Crosses with (R.Clinophylla x R. Bracteata) B as Pollen Parent

S.No.	Seed Parent	No. of Crosses	Hips	Seed	Seedlings	Remarks
1.	T <sub>3</sub> (Boquet D'Or?). Tea	2	—	—	—	
2.	T <sub>4</sub> (Mrs. B. R. Cant?). Tea	3	—	—	—	
3.	T <sub>5</sub> (Marie Van Houtte?). Tea	1	1	—	—	
4.	T <sub>7</sub> (Celine Forrestier?). Noisette	3	—	—	—	
5.	Bharani. Polyantha	4	—	—	—	
6.	Little Darling. Floribunda	28	23	150+	4	Not yet Flowered
7.	Julien Potin. Hybrid Tea	1	—	—	—	
8.	Queen Elizabeth. Hybrid Tea	2	2	10	—	
9.	Rosy Mantle. Climbing Hybrid Tea	26	22	6	Still to germinate	
10.	Lover's Meeting. Hybrid Tea	1	—	—	—	
11.	Self of (R.Clinophylla R Bracteata) B	12	3	12	5	Large variation in size/rate of growth F <sub>1</sub> plants.

As regards *R. Bracteata*, intercrossing with the Teas, only six germinations were recorded in cross ( $T_1$  Mrs.B.R. Cant? x *R. Bracteata*) of which one dwarf repeat flowering seedling has survived, which should be useful for further work. *R.Clinophylla* crossed into tetraploids listed above has not yielded any results. But there is one dwarf Floribunda type seedling resulting from the cross (Little Darling x *R. Bracteata*) with cream single flowers.

The only real success of the breeding programme is the raising of seedlings from the cross (*R.Clinophylla* x *R.Bracteata*). Of these seedlings five were treated at the first true leaf stage with 0.1% aqueous solution of colchicine, with the hope of inducing tetraploids. Two different treatments were adopted - a) immersion of the entire seedling (excepting for the root) in 0.1% colchicine for 8 hours, and b) treatment of the growing tip with 0.1% colchicine, 3 times daily for one week.

Two seedlings, identified as (*Clinophylla* x *Bracteata*) B and (*Clinophylla* x *Bracteata*) C have survived these treatments arising from the adoption of methods (a) and (b) respectively.

Of these, (*Clinophylla* x *Bracteata*) B has shown exceptional growth and freedom of flowering. Judged by appearances, this is very close to *R.Bracteata*, the pollen parent. Several crosses have been made using this as pollen parent, as shown in Table III. The choice of tetraploid seed parents was based on the assumption that the seedling was a tetraploid. Subsequent investigations by Sambandamurthy et al of Tamil Nadu Agricultural University<sup>11</sup> showed however that this is a diploid with 14 chromosomes.

As is evident from Table III, the cross, tetraploid garden rose x *Clinophylla* x *Bracteata* is also one which is difficult to achieve. However, four seedlings from the cross (Little Darling x (*Clinophylla* x *Bracteata*) B) have survived but are yet to flower after one growing season. Judged by appearance, they are much closer to Little Darling, the tetraploid parent, which is obviously what should be expected. Five self seed-



lings of (*Clinophylla* x *Bracteata*) B have also been raised, which would hopefully be more fertile than the parent.

As using *R.Clinophylla*/*R.Bracteata* as pollen parents proved to be of little use, using them as seed parents was tried for the first time during 1989. The pollen parents used were the polyanthas, *Perle d'Or*, *Cecile Brunner*, as well as certain Hybrid Teas/*Floribundas* viz., *Montezuma*, *Royal Gold*, *Fidelio*, etc. A considerable quantity of seed has been harvested with the cross of *R.Clinophylla* and *R.Bracteata* with *Perle d'Or*/*Cecile Brunner*. Germination has not yet commenced - October 1990. But there is yet time. Preliminary indications seem to be that using *R.Clinophylla*/*R.Bracteata* as seed parents would be more fruitful.

Before closing this account of work done with *R.Clinophylla*/*R.Bracteata* we venture on the following general points, which, hopefully, would be of use to other rose breeders. Clearly, *R.Clinophylla* is genetically very distant from modern roses. There is also the problem of its being a diploid, whereas modern roses are generally tetraploid.

Additionally, *R.Clinophylla* is, under Kodaikanal conditions, highly susceptible to both mildew and black spot. Unlike its close relative, *R.Bracteata*, which, as mentioned earlier, is almost immune. The seedling (*Clinophylla* x *Bracteata*) B is also susceptible to mildew/black spot, though much healthier than *R.Clinophylla* itself.

According to the work done by Dr. A. V. Roberts et al<sup>12</sup>, there would appear to be two different types of resistances to infection by black spot. The first type, based on cuticular resistance, and the second type, chemically based. According to these authors, 'from the breeder's point of view, a type of resistance is needed which reappears in at least a proportion of the progeny in undiminished strength. Such might be the case where resistance is conferred by a chemical that is controlled by a small number of genes.'

While we do hope that the resistance of *R.Bracteata* is due to genetically controlled chemical factors, visual impressions

(which may be quite wrong) appear to indicate that the resistance is of cuticular origin.

One other problem in breeding with *R. Clinophylla* arises from the thin petal texture of the flowers, no doubt due, partly at least, to the diploid chromosome number. Petal texture is a factor of great importance when breeding roses for warm climates and hopefully, this problem could be overcome if tetraploid progeny with the genes of *R. Clinophylla* could be evolved by selective breeding.

We may mention in passing that detailed studies on the relation between corolla thickness and parentage of roses of the type done for rhododendrons by Pat Halligan<sup>13</sup> would be very useful indeed for rose breeders.

Breeding with *R. Clinophylla* apart, we require a general strategy for rose breeding for the tropics. Here, the answer would be to concentrate on breeding roses which are evergreen as distinct from deciduous. We may observe that the deciduous characteristic has incidentally been encouraged by temperate climate rose breeding with an emphasis on winter hardiness. But in the tropics the situation is entirely different, and breeding an evergreen rose is well within the realms of possibility. It is of interest to note that some of the evergreen rose species e.g. *R. Bracteata* itself, *R. Laevigata*, *R. Sempervirens*, have some of the most beautiful rose foliage imaginable. As far back as 1854, the well known English rosarian, Thomas Rivers, writing about *R. Bracteata* and its good qualities, said he hoped that ultimately gardeners would not be satisfied unless all roses had evergreen foliage, brilliant and fragrant flowers, and a long season of flowering. This might seem, he said an extravagant anticipation, but perseverance in breeding would yet achieve wonders.<sup>14</sup>

In more modern times, authorities such as Stelvio Cogliati<sup>15</sup> and Sam McGrady<sup>16</sup> have emphasized the need for beautiful rose foliage; in other words, evergreen foliage. McGrady has this to say- 'Plant qualities are going to be important in the future. We tend to look on roses at present as something to fill a bed with colour for a few months, of the year. But I

TABLE IV

## HYBRIDS OF EVERGREEN ROSE SPECIES

S.No.	Evergreen Species	Hybrid Variety	Parentage	Remarks
1.	R. BRACTEATA	MERMAID	R. BRACTEATA x YELLOW TEA ROSE	Rampant everblooming climber with beautiful foliage and single cream flowers.
2.	R. BRACTEATA/ R. LAEVIGATA	MARIE LEONIDA	R. BRACTEATA x LAEVIGATA	Climber with large full cupped, yellowish, white flowers glossy foliage.
3.	R. LAEVIGATA	SINACA ANEMONE	R. LAEVIGATA x TEA ROSE	Climber with clear pink single flowers
4.	R. LAEVIGATA/ R. WICHURIANA	SILVER MOON	R. WICHURIANA x DEVONIENSIS	Large Pale yellow flowers, semi double, on strong stems, foliage dark, leathery, glossy.
5.	R. SEMPERVIRENS	ADELAIDE DE ORLEANS	R. SEMPERVIRENS x Unknown	Climber with semi double pale pink flowers
6.	R. SEMPERVIRENS	BONICA (Mei do monac)	(R. SEMPERVIRENS x MARTHE CARRON) x PICASSO	Shrub rose Pink flowers AARS 1982. Marthe Carron is pure R. Wichuriana.
7.	R. BANKSIAE/ R. LAEVIGATA	FORTUNIANA	R. BANKSIAE x R. LAEVIGATA	Double white climber Widely used as rootstock
8.	R. BANKSIAE	PUREZZA	TOM THUMB x R. BANKSIAE	White climber with profuse clusters.
8.	R. CLINOPHYLLA	LUCINDA DUPLEX	SPORT OR SEEDLING OF R. CLINOPHYLLA	Large double flower of white with rosy flush. Described by William Paul in "The Rose Garden" 1848.



think that roses - or some roses - are going to become garden plants of beauty whether the blooms are on them or not'.

While such thinking may appear novel, as far as roses go, the importance of foliage has long been recognised in other garden plants e.g. rhododendrons, where evergreen foliage and the capacity of the plant to hold foliage in good condition for several years has long been prized e.g. the article 'Forget the flowers, breed for leaves' by Dr. M. J. Harvey<sup>1</sup>

The romantic, indeed alluring, prospect of roses with brilliant evergreen foliage would appear to be well within the realms of practical possibility. Among the various rose species the following are evergreen or nearly so - *R. Clinophylla*, *R. Bracteata*, *R. Sempervirens*, *R. Banksia*, *R. Laevigata*, *R. Wichuriana*. All of them, apart from beautiful evergreen foliage, share one very important characteristic - viz., of being species native to the warmer portions of the world. The link between evergreen foliage and warm climate is hopefully very close indeed, and should be a source of inspiration for future rose breeders of the tropics. Several hybrids have already been raised using various evergreen species (see Table IV which gives an illustrative list) but, as could be expected, evergreen foliage was not the main object with which the crosses were made. This fascinating prospect is left to the rose breeders of the future.

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